

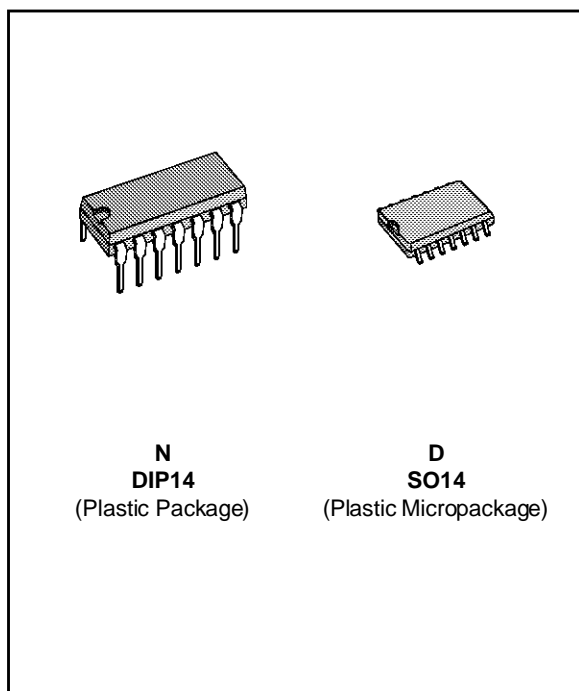
## LOW POWER QUAD VOLTAGE COMPARATORS

- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES FOR ALL DEVICES : +2V TO +36V OR  $\pm 1V$  TO  $\pm 18V$
- VERY LOW SUPPLY CURRENT (1.1mA) INDEPENDENT OF SUPPLY VOLTAGE (1.4mW/comparator at +5V)
- LOW INPUT BIAS CURRENT : 25nA TYP
- LOW INPUT OFFSET CURRENT :  $\pm 5nA$  TYP
- LOW INPUT OFFSET VOLTAGE :  $\pm 1mV$  TYP
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE : 250mV TYP. ( $I_o = 4mA$ )
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE
- TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS

### DESCRIPTION

These devices consist of four independent precision voltage comparators with an offset voltage specifications as low as 2mV max for LM339A, LM239A and LM139A. All these comparators were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage.

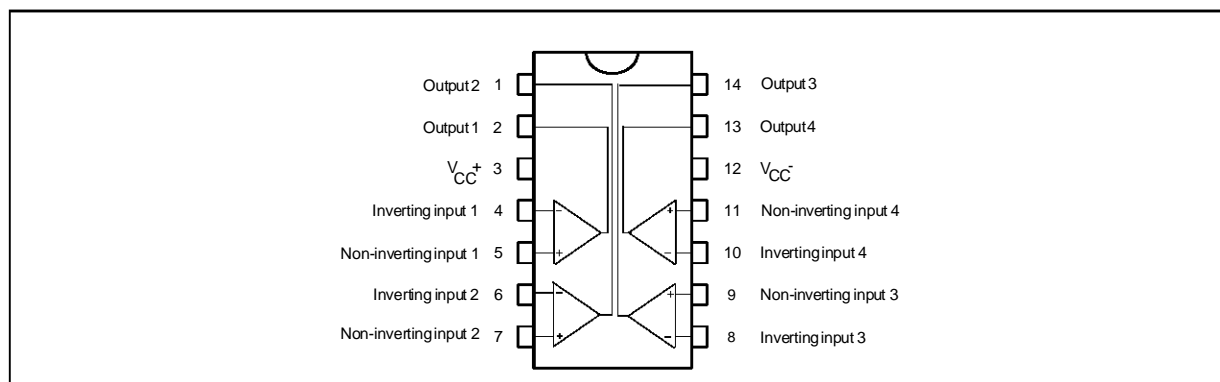


### ORDER CODES

Part Number	Temperature Range	Package	
		N	D
LM139,A	-55, +125°C		
LM239,A	-40, +105°C		
LM339,A	0, +70°C	•	•

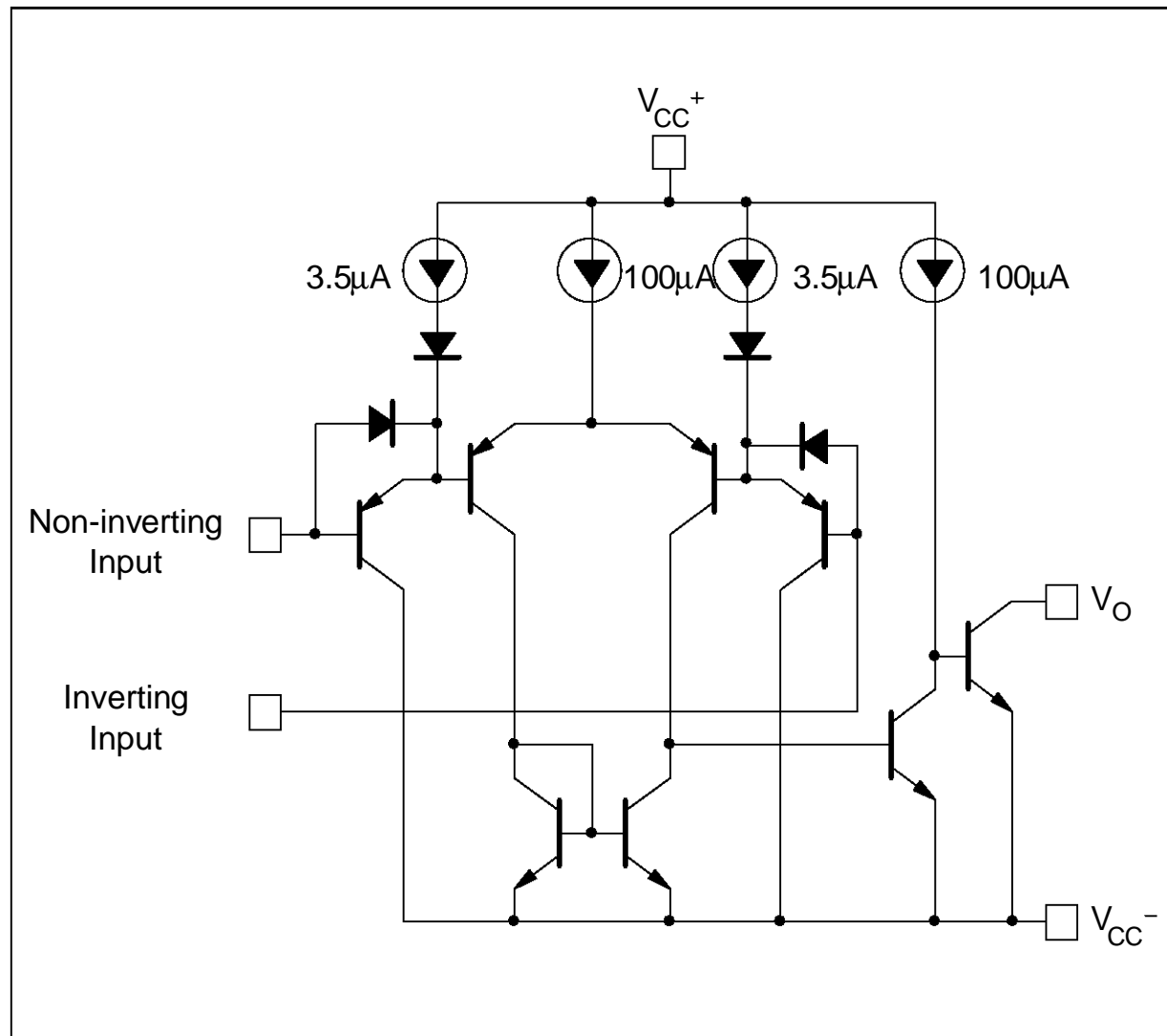
**Example :** LM139AN

### PIN CONNECTIONS (top view)



# LM139,A - LM239,A - LM339,A

## SCHEMATIC DIAGRAM (1/4 LM139)



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM139,A LM239,A	LM339,A	Unit
$V_{CC}$	Supply Voltage	$\pm 18$ to 36	$\pm 18$ to 36	V
$V_{id}$	Differential Input Voltage	$\pm 36$	$\pm 36$	V
$V_i$	Input Voltage	-0.3 to +36	-0.3 to +36	V
	Output Short-circuit to Ground - (note 1)	Infinite		
$P_{tot}$	Power Dissipation	570	570	mW
$T_{oper}$	Operating Free-air Temperature Range LM239,A	-55, +125 -40, +105	0, +70	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature Range	-65, +150	-65, +150	$^{\circ}\text{C}$

**Notes :** 1. Short-circuit from the output to  $V_{CC}^+$  can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of  $V_{CC}^+$ .

**ELECTRICAL CHARACTERISTICS**

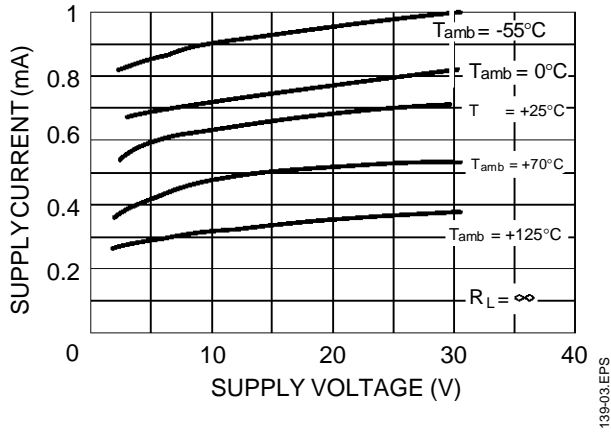
$V_{CC}^+ = +5V$ ,  $V_{CC}^- = GND$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

Symbol	Parameter	LM139A - LM239A LM339A			LM139 - LM239 LM339			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$V_{io}$	Input Offset Voltage – (note 2) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	2 4		1	5 9	mV
$I_{io}$	Input Offset Current $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		3	25 100		5	50 150	nA
$I_{ib}$	Input Bias Current ( $I_{I^+}$ or $I_{I^-}$ ) - (note 3) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		25	100 300		25	250 400	nA
$A_{vd}$	Large Signal Voltage Gain ( $V_{CC} = 15V$ , $R_L = 15k\Omega$ , $V_O = 1$ to $11V$ )	50	200		50	200		V/mV
$I_{CC}$	Supply Current (all comparators) $V_{CC} = +5V$ , no load $V_{CC} = +30V$ , no load		1.1 1.3	2 2.5		1.1 1.3	2 2.5	mA
$V_{icm}$	Input Common Mode Voltage Range - (note 4) ( $V_{CC} = 30V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	0 0		$V_{CC}^+ - 1.5$ $V_{CC}^+ - 2$	0 0		$V_{CC}^+ - 1.5$ $V_{CC}^+ - 2$	V
$V_{id}$	Differential Input Voltage - (note 6)			$V_{CC}^+$			$V_{CC}^+$	V
$V_{OL}$	Low Level Output Voltage ( $V_{id} = -1V$ , $I_{sink} = 4mA$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		250	400 700		250	400 700	mV
$I_{OH}$	High Level Output Current ( $V_{id} = 1V$ ) ( $V_{CC} = V_O = 30V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		0.1	1		0.1	1	nA $\mu A$
$I_{sink}$	Output Sink Current ( $V_{id} = -1V$ , $V_O = 1.5V$ )	6	16		6	16		mA
$t_{re}$	Response Time – (note 5) ( $R_L = 5.1k\Omega$ connected to $V_{CC}^+$ )		1.3			1.3		$\mu s$
$t_{rel}$	Large Signal Response Time ( $R_L = 5.1k\Omega$ connected to $V_{CC}^+$ , $e_1 = TTL$ , $V_{(ref)} = +1.4V$ )		300			300		ns

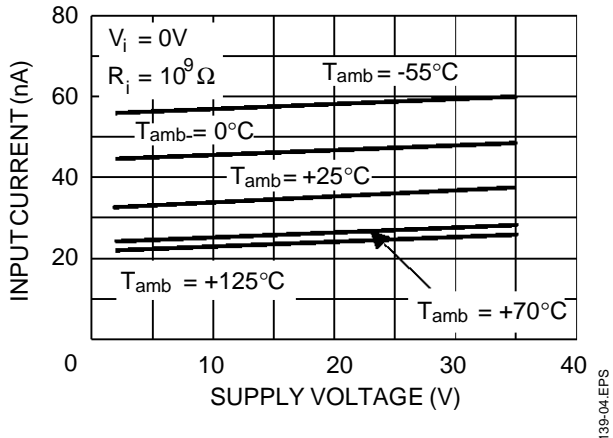
- Notes :**
- At output switch point,  $V_O \approx 1.4V$ ,  $R_s = 0$  with  $V_{CC}^+$  from 5V to 30V, and over the full input common-mode range (0V to  $V_{CC}^+ - 1.5V$ ).
  - The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines.
  - The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is  $V_{CC}^+ - 1.5V$ , but either or both inputs can go to +30V without damage.
  - The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals 300ns can be obtained.
  - Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than  $-0.3V$  (or 0.3V below the negative power supply, if used).

139-03.TBL

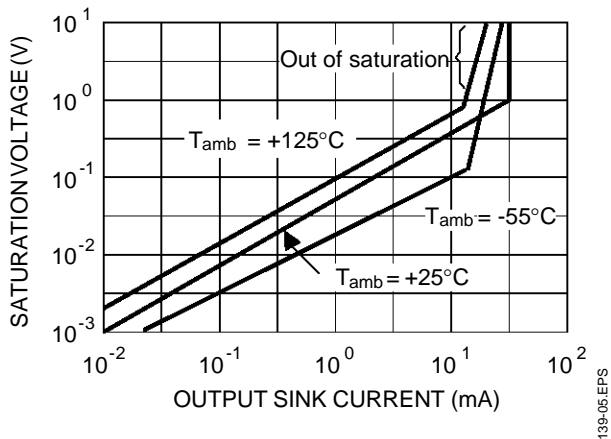
SUPPLY CURRENT versus SUPPLY VOLTAGE



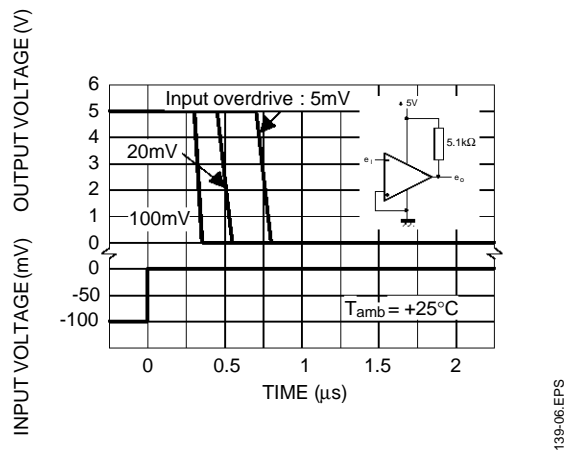
INPUT CURRENT versus SUPPLY VOLTAGE



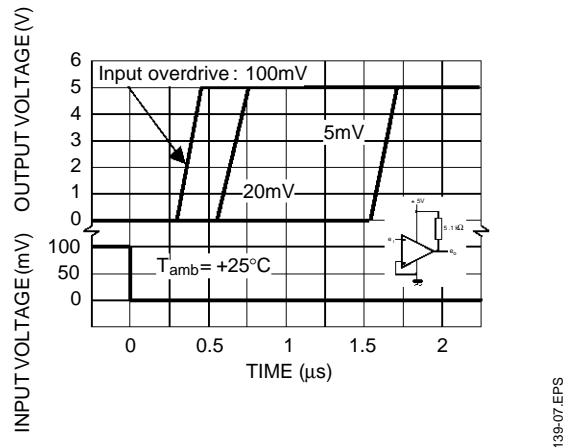
OUTPUT SATURATION VOLTAGE versus OUTPUT CURRENT



RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION

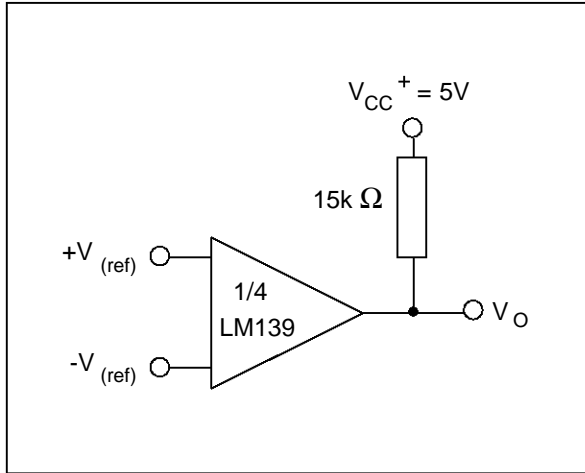


RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

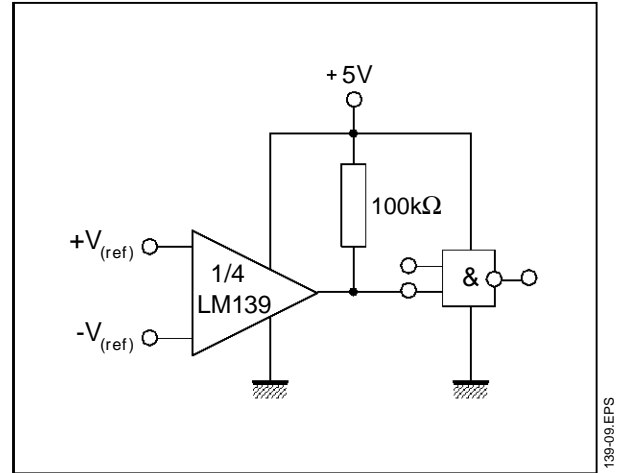


TYPICAL APPLICATIONS

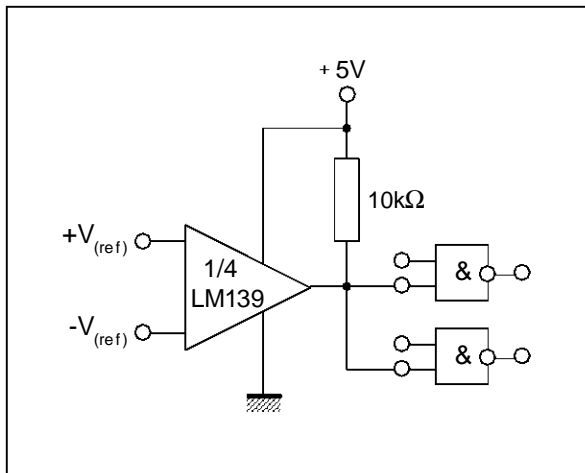
BASIC COMPARATOR



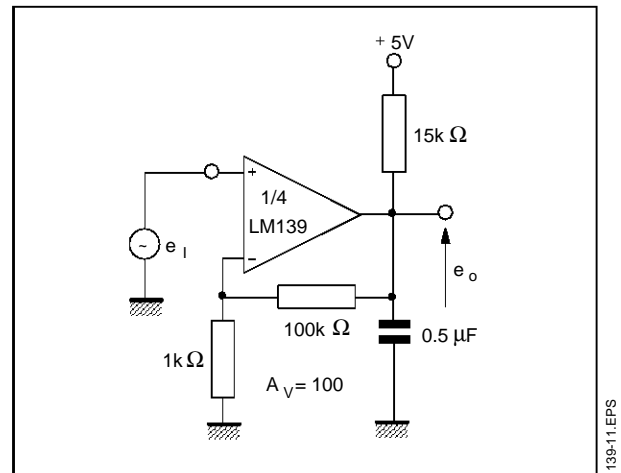
DRIVING CMOS



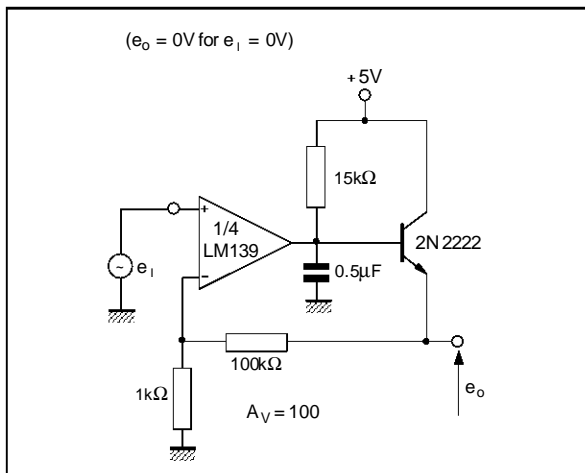
DRIVING TTL



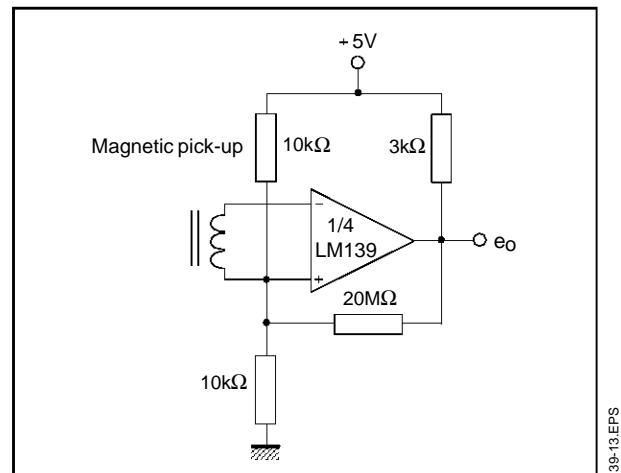
LOW FREQUENCY OP AMP



LOW FREQUENCY OP AMP

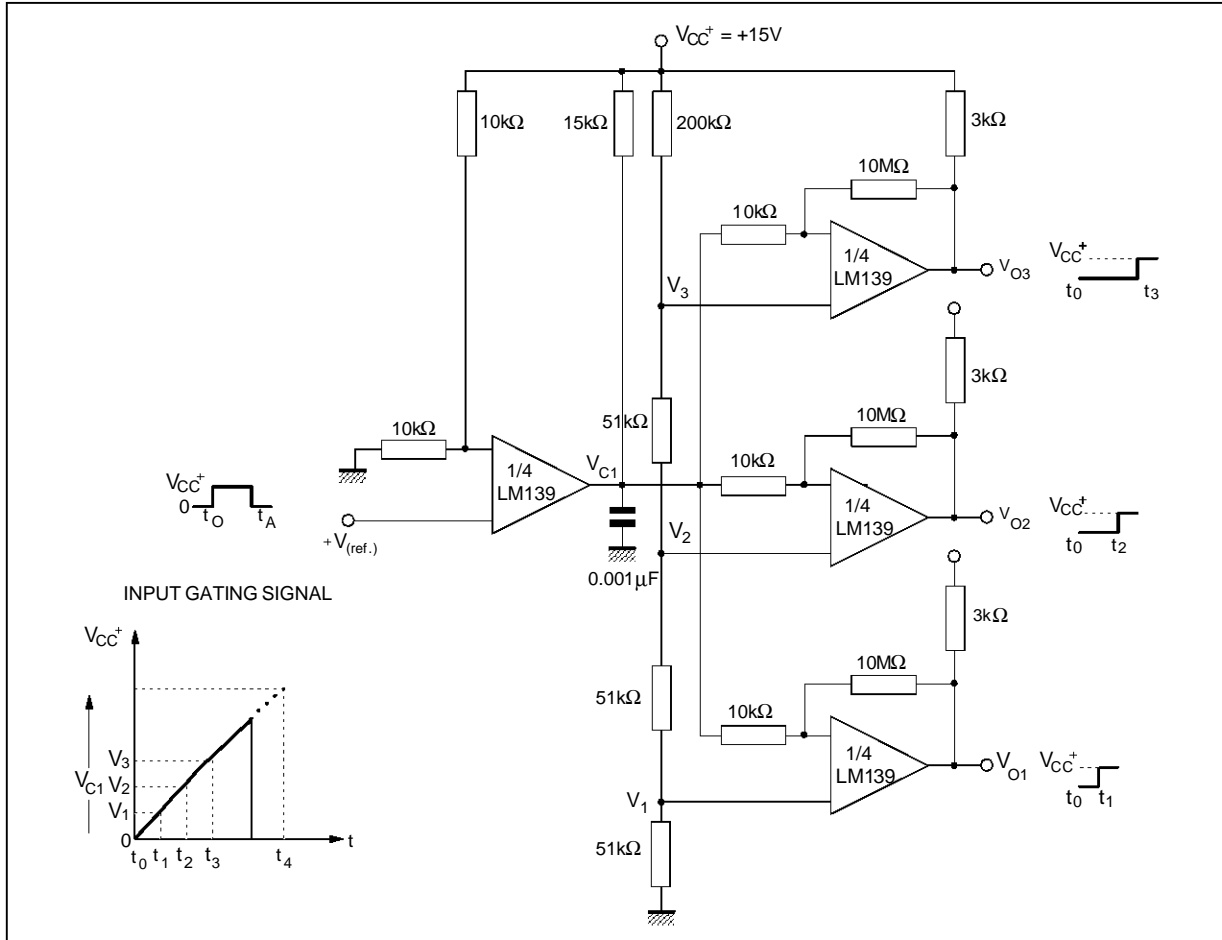


TRANSDUCER AMPLIFIER

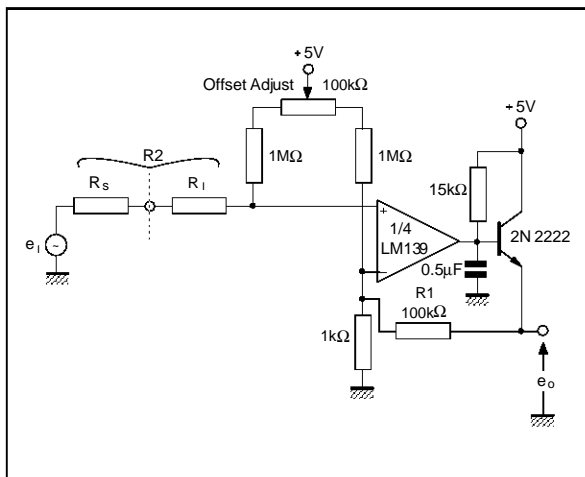


TYPICAL APPLICATIONS (continued)

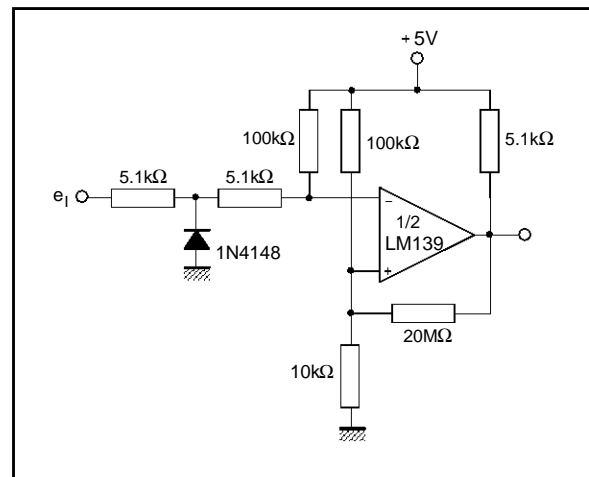
TIME DELAY GENERATOR



LOW FREQUENCY OP AMP WITH OFFSET ADJUST

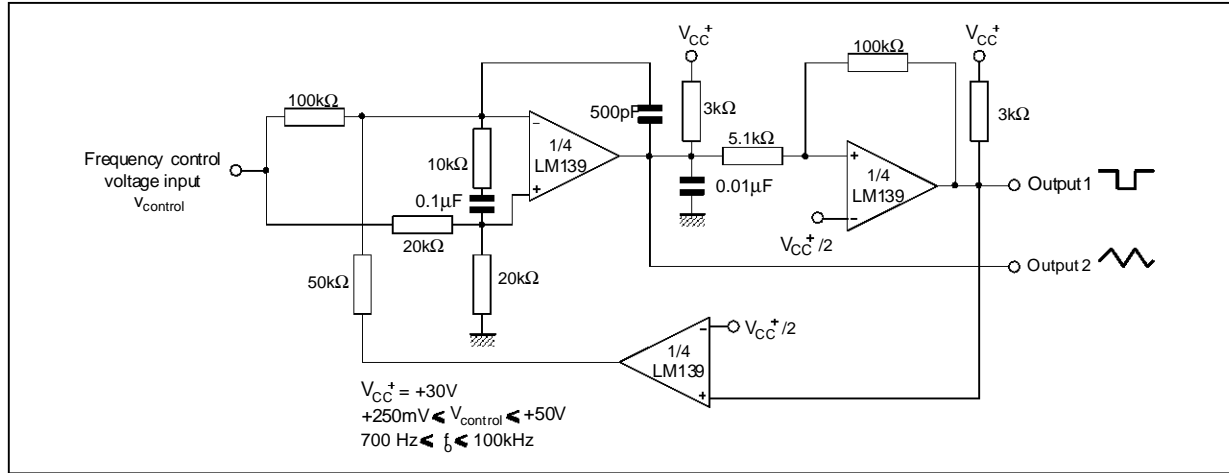


ZERO CROSSING DETECTOR (single power supply)

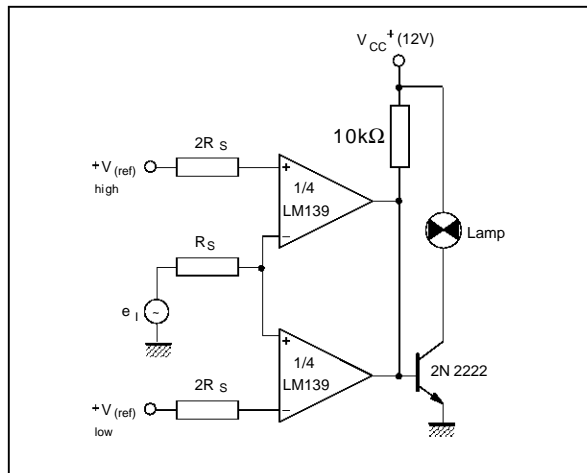


TYPICAL APPLICATIONS (continued)

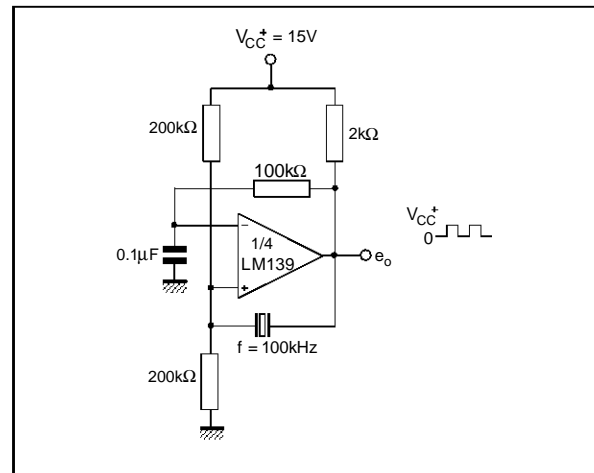
TWO-DECADE HIGH-FREQUENCY VCO



LIMIT COMPARATOR

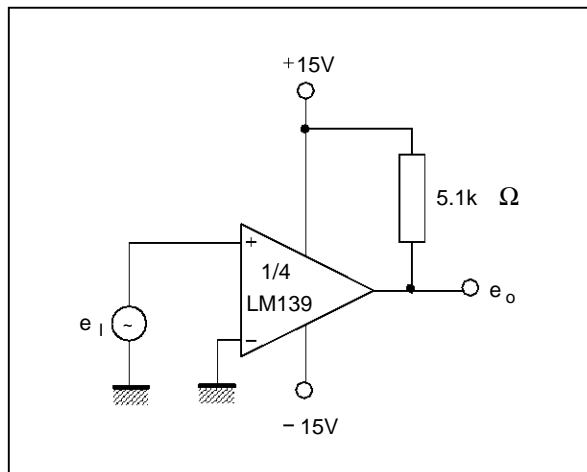


CRYSTAL CONTROLLED OSCILLATOR

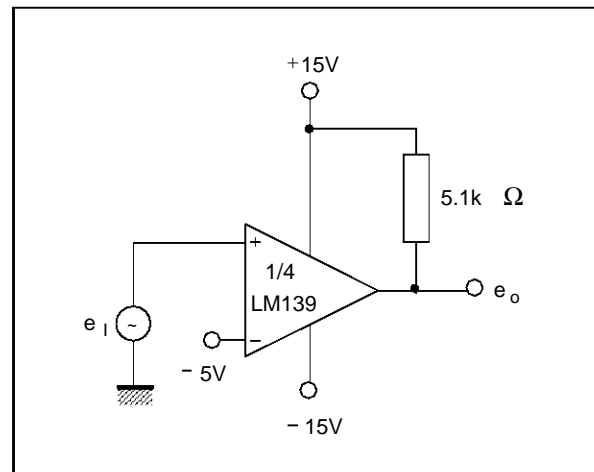


SPLIT-SUPPLY APPLICATIONS

ZERO CROSSING DETECTOR

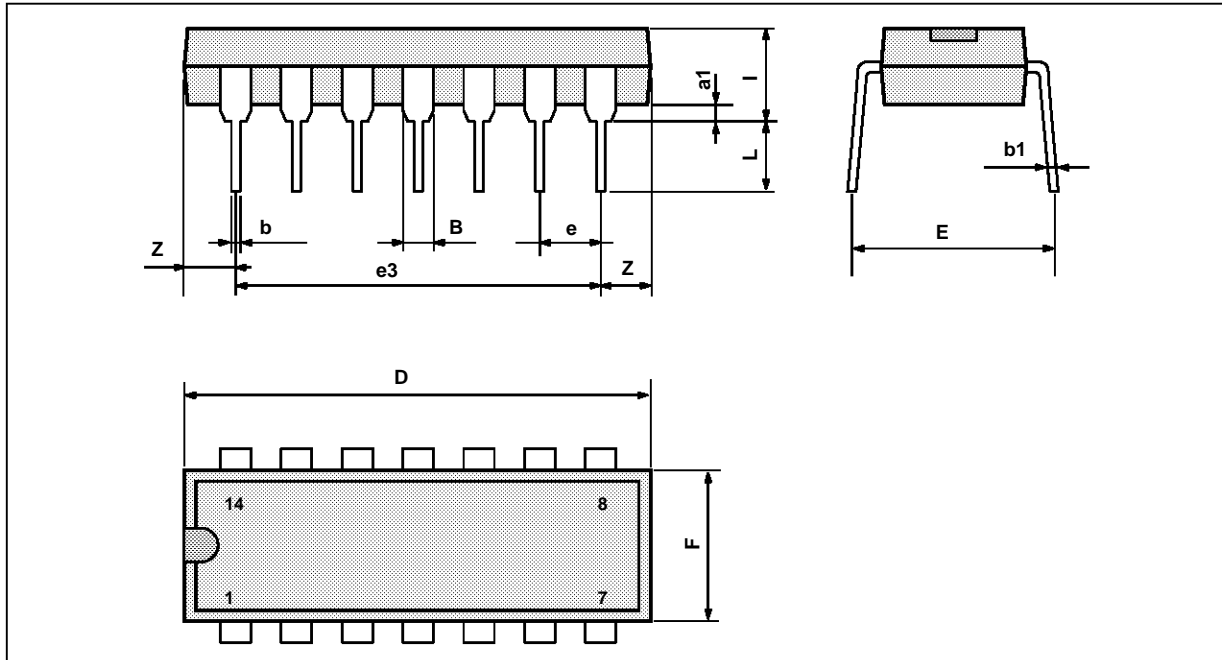


COMPARATOR WITH A NEGATIVE REFERENCE



LM139,A - LM239,A - LM339,A

PACKAGE MECHANICAL DATA  
14 PINS - PLASTIC DIP OR CERDIP



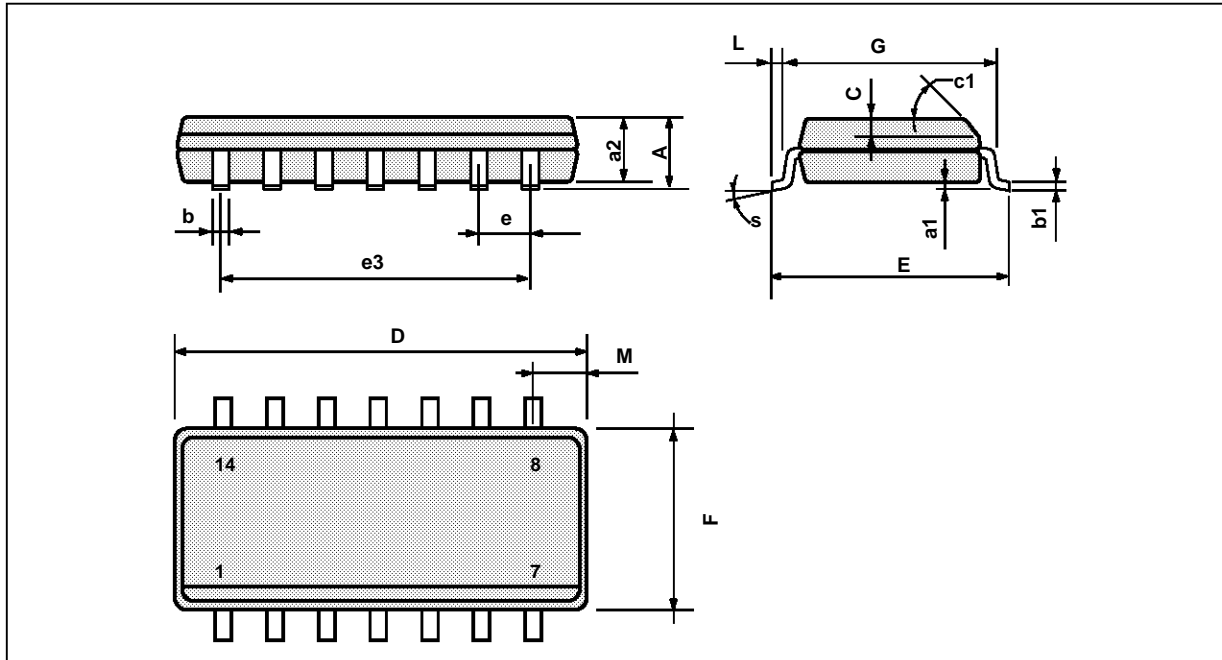
PM-DIP14LFS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

DIP14,TBL



**PACKAGE MECHANICAL DATA**  
14 PINS - PLASTIC MICROPACKAGE (SO)



PM-SO14.EPS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

SO14.TBL

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